FAUNAL BREAKS IN TASMANIA AND THEIR SIGNIFICANCE FOR INVERTEBRATE CONSERVATION

ROBERT MESIBOV

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Faunal breaks are narrow landscape zones in which invertebrate species assemblages change more or less abruptly. At least three faunal breaks are found on the main island of Tasmania, each coincident with an ecotone which may act as a dispersal barrier. It is argued that faunal breaks need to be conserved for their value in reconstructing the historical zoogeography of a wide range of invertebrate taxa. ☐ Conservation, invertebrates, parapatry, Tasmania, zoogeography.

Robert Mesibov, P.O. Box 700, Burnie, Tasmania 7320, Australia; 11 May 1994.

'Tasmania itself, regarded from a zoogeographical point of view, is not a single homogeneous unit.' (Smith, 1909: 145)

Although regional variation in the Tasmanian fauna has long been recognised (see epigraph), it has only recently become apparent that regional changes in species assemblages can occur over relatively short distances and involve a broad range of taxa. Such localised changes are here called 'faunal breaks'. This paper briefly summarises current knowledge of faunal breaks in Tasmania and proposes directions for their further study and conservation.

EXAMPLES

Tyler's Line

The name 'Tyler's Line' was given by Shiel et al. (1989) to the eastern range boundary of a rotifer species assemblage in western Tasmania. The eponymous Peter Tyler has pointed out that the line is more than a limnological divide; it is 'a congruence of climatic, geologic, edaphic and vegetational change' (Tyler, 1992: 358). Solid and dashed lines (Fig. 1) are parapatric boundaries between (a) the grasshoppers *Russalpia albertis* (Bolivar 1898) (east) and *R. longifurca* Key, 1991 (west), after Key (1991); (b) the frogs *Litoria burrowsi* (Scott, 1942) (west) and *L. raniformis* (Keferstein, 1867) (east), after Martin & Littlejohn (1982) and unpublished records (P. Brown, pers. comm. and T. Kingston, pers. comm.) and (c) the freshwater decapods *Astacopsis franklinii* (Gray, 1845) (east) and *A. tricornis* Clark, 1936 (west), after Hamr (1992). Dotted lines are eastern boundaries of (d) the terrestrial amphipod *Neorchestia plicibrancha* after Friend (1987), and (e) the grasshopper *Truganinia bauerae*, after Key (1991). Less complete distribution data suggest that Tyler's Line is respected by land snails (Smith & Kershaw, 1981; e.g. *Mulathena fordei* (Brazier, 1871), *Victaphanta milligani* (Pfeiffer, 1853)), caddis flies (Neboiss, 1981; e.g. *Ecnomus russellius* Neboiss, 1977, *Plectrocnemia manicata* Neboiss, 1977, *Triplectides bilobus* Neboiss, 1977), skinks (Rawlinson, 1974, and Hutchinson et al., 1989; e.g. the apparently parapatric *Niveoscincus microlepidotus* (O'Shaughnessy, 1874) and *N. ocellatus* (Gray, 1845) and freshwater decapods of *Parastacoides* (A. Richardson, pers. comm.).

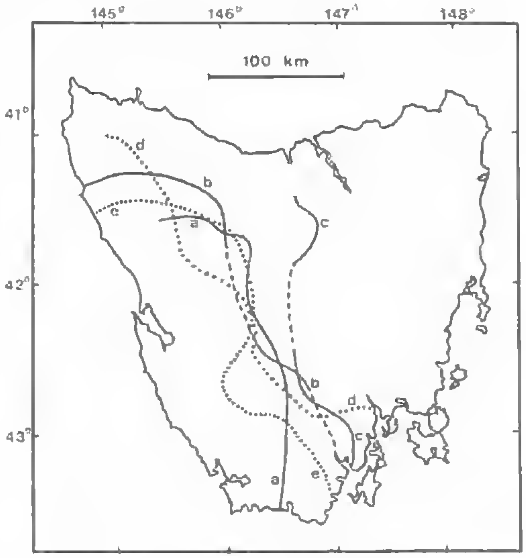

Fig. 1. Tyler's Line. See text for explanation.

Plomley's Island and Environs

Two dalodesmid millipede species, *Lissodesmus alisonae* Jeekel, 1984 (triangles) and *Lis-*

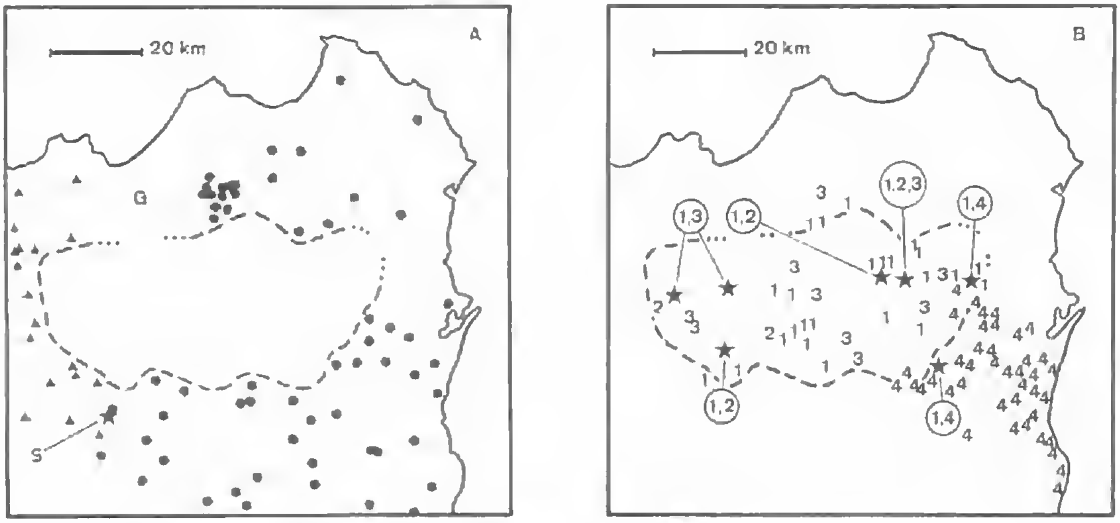

FIG. 2A, B. Plomley's Island. See text for explanation.

sodesmus n. sp. E1 (dots), are parapatric and co-occur at the site 'S' (Fig. 2A; from Mesibov, 1993). Neither species is known in area 'G', here called Bridport Gap, which coincides with the western range boundary of another dalodesmid, *Lissodesmus* n.sp. NE5 (Mesibov, 1993).

The 'hole' in combined distributions of *L. alisonae* and *L.* n.sp. E1 (see dashed line Fig. 2), contains nearly all known localities of three unrelated invertebrates (Fig. 2B): (1) the land snail *Anoglypta launcestonensis* (Reeve, 1853) (after Kershaw, 1988), (2) the geophilomorph centipede *Tasmanophilus* sp. (records as used in Mesibov, 1986) and (3) the dalodesmid millipede *Gasterogramma* n.sp. 5 (Mesibov, 1993). The oblong area (dashed line, Fig. 2) is here called Plomley's Island, after the late historian, N.J.B. Plomley, who has for many years encouraged natural history studies in northeast Tasmania. The eastern 'edge' of Plomley's Island is here called Gould's Country Break. It coincides with western range boundaries of the onychophoran *Tasmanipatus barretti* Ruhberg et al., 1991 (localities marked '4' in Fig. 2B, after Mesibov & Ruhberg, 1991 and Mesibov, unpublished records) and apparently the terrestrial amphipod *Keratroides pyrensis* Friend, 1987, as well as the eastern range boundary of *Lissodesmus adrianae* Jeekel, 1984 (Mesibov, 1993). East Tamar Break on the western 'edge' of Plomley's Island appears to coincide with eastern range boundaries for the dalodesmids *Gasterogramma psi* Jeekel, 1982 and *Tasmanodesmus hardyi* Chamberlin, 1920 and western range boundaries for *Lissodesmus adrianae* and *L.* n.sp. NE1 (Mesibov, 1993). Western and eastern faunal breaks on the boundary of Plomley's Island thus involve at least eight and seven species, respectively, from five invertebrate groups: amphipods, centipedes, millipedes, onychophorans and snails.

Other Faunal Breaks

There is limited evidence for nine other faunal breaks on the main island of Tasmania, including the Bridport Gap referred to above (Mesibov, unpublished data). Several 'breaks' may be relatively diffuse (up to 30km wide), while others may involve only the few species so far known to respect them. I regard these possible breaks as zoogeographical hypotheses to be tested by future fine scale mapping of a range of taxa.

ORIGINS

Faunal breaks in Tasmania generally correspond with ecotones. Environmental gradients along portions of Tyler's Line, for example, are demonstrably steep (Tyler, 1992), as are altitudinal gradients on the east and west 'edges' of Plomley's Island. An ecotone at a faunal break might mark the distribution limit of habitats preferred by break-respecting species, and in the case of parapatric species pairs, ecotonal change might facilitate parapatry caused by other mechanisms (Bull, 1991). However, for slow-dispersing invertebrates (e.g. millipedes and land snails), an ecotone may represent a dispersal barrier, with ample suitable habitat on the other side.

Some invertebrates respecting a faunal break are limited by barriers, others by habitat. Parapatric species pairs are also a problematic feature of faunal breaks. To paraphrase Key (1991), while a steep environmental gradient may have determined the location of a faunal break involving parapatry, it may not have been responsible for its existence. In the grasshopper *Russalpia* (see Fig. 1), Key (1991) proposed that the common ancestor of *R. albertisi* and *R. longifurca* was distributed widely enough for two populations to have been reproductively isolated by an intervening barrier. This barrier may have been ice-covered and periglacial high country of central Tasmania during Pleistocene glacial maxima. 'Following the spread of warmer conditions at c. 7000 B.P., one or both of the now differentiated populations could have spread into the formerly glacial areas until they met and produced the [hybrid] tension zone. This in turn may have moved westward or eastward to reach its present position.' (Key, 1991: 286). Alternatively, *Russalpia* may have speciated sympatrically or parapatrically at Tyler's Line ecotone during non-glacial times. More generally, the more congeneric species pairs at a faunal break, the more likely that the break is located near a past barrier responsible for allopatric speciation, or at an ecotone responsible for sympatric or parapatric speciation. Faunal breaks thus offer insights into evolutionary history, and phylogenetic analysis might reveal the sequence in which sets of barriers or ecotones were operative in the evolution of the taxa.

CONSERVATION

If faunal breaks divided Tasmania into discrete zoogeographical units, then a simple basis would be available for planning future sampling effort and for proposing regionally representative fauna reserves. Unfortunately, Tasmania is far from being a neat zoogeographical mosaic. Even if careful mapping of invertebrate distributions allowed us to draw 'consensus' boundaries for Tasmanian zoogeographical provinces, the usefulness of such provinces for conservation purposes would be compromised by the fact that many invertebrates, e.g. megascolecid earthworms (Jamieson, 1974; T. Kingston, pers. comm.), have very restricted distributions. High priorities would have to be assigned to such species within today's taxon-focussed conservation paradigm, yet geographically restricted invertebrates stand outside any system of provinces. A more significant concern is that individual faunal boundaries may involve only a fraction of the local fauna. What level of local endemicity would justify the division of Tasmania into faunal provinces? The threshold would have to be well above the 'noise level' for invertebrate distribution data. As Buzas et al. (1982) and Koch (1987) have shown, the typical pattern of invertebrate species abundances, namely the Fisher log series, gives rise to false absences in sampling with a disconcertingly high probability. For example, a large group of invertebrate samples was shown to exhibit a unique species proportion of 25% in comparison with an equal number of samples drawn later from precisely the same data set of species occurrences (Koch, 1987).

The problem is illustrated by the Tasmanian Trichoptera records of Neboiss (1981). Distribution maps for 163 species were presented showing occurrences in seven proposed faunal provinces on the main island. If the provinces are grouped into 'west of Tyler's Line' (northwest + southwest) and 'east of Tyler's Line' (north + northeast + east + southeast + central), then the two resulting superprovinces have about the same number of trichopteran species: 133 in the west, 125 in the east. The proportion of eastern species which are unique to that superprovince is only 24%, and more than half the unique species were recorded from only one or two localities. Such one- or two-site species might actually be widespread and uncommon, rather than geographically restricted. Neboiss et al. (1989) later reported that four of the 30 'uniquely eastern' species had since been found in southwest Tasmania (namely *Costora seposita* Neboiss, 1977, previously known from one eastern site; *Hydroptila tasmanica* Mosely, 1934, from one; *Oecetis laustra* Mosely, 1953, from one; and *Orphninotrichia acta* Neboiss, 1977, from two). It is likely that percentage differences in species lists across any of Tasmania's faunal breaks would be at the level expected from random sampling of a uniformly distributed fauna (vide Koch, 1987). Faunal breaks are demonstrable, but faunal provinces may not be.

DISCUSSION

Recognition of faunal breaks, together with recent fine scale mapping of geographically restricted invertebrates (e.g. Horwitz, 1991; Mesibov & Ruhberg, 1991; and Taylor, 1991), has shown that invertebrate sampling in Tasmania needs to be carefully planned on a geographical basis. The main island is intricately regionalised and it is unwise to assume that invertebrate species are distributed more than a few km from known localities. It is also becoming clear that faunal breaks are potentially rich sources of information on the historical zoogeography of Tasmania and the evolution of its invertebrate fauna. For this reason I suggest that faunal breaks need to be protected, both from destruction by habitat clearance and from faunal impoverishment through ill-considered land use. There is more valuable zoological information to be conserved along a faunal break, even where habitats have been disturbed, than in a 'pristine' or little modified tract of native vegetation well within a faunally homogeneous area.

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